



JOHN F. KENNEDY  
SPACE CENTER

KSC-KHB 1840.1/1S

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# INDUSTRIAL HYGIENE HANDBOOK

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National Aeronautics and  
Space Administration

John F. Kennedy Space Center

**NASA**

# TRANSMITTAL SHEET

TC

STD-L-P; Special

DATE

October 2, 1973

## MATERIAL TRANSMITTED

KHB 1840.1/IS, Change 2, "Industrial Hygiene Handbook"

This change is issued to update the Toxic Materials Control List in Section VII, "Control of Toxic Materials".

*for* *C. C. Barber*  
Frederic H. Miller  
Director of Installation Support

## FILING INSTRUCTIONS

- Remove and replace List of Effective Pages (between Cover and Preface pages)
- Remove and replace Pages v/vi and vii/viii - OK
- Remove and replace Section VII pages OK

TRANSMITTAL SHEET


Recipients of KHB 1840.1/IS, "Industrial Hygiene Handbook"

DATE

August 15, 1973

MATERIAL TRANSMITTED

Change 1, is issued to add Section VIII, "Tank and Confined Space Entry".

  
Frederic H. Miller  
Director of Installation Support

FILING INSTRUCTIONS

- Add List of Effective Pages between Cover and Preface pages.
- Remove and replace Pages v/vi and vii/viii.
- Add Section VIII Pages following Section VII.
- Remove and replace Appendix A pages.



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
JOHN F. KENNEDY SPACE CENTER  
KENNEDY SPACE CENTER, FLORIDA 32899



REPLY TO  
ATTN OF:

IS-MED-A

JUN 1 2 1974

## MEMORANDUM

TO: Distribution

FROM: IS-MED-A/Environmental Health Officer

SUBJECT: Control of Toxic Materials

NASA JOHN F. KENNEDY SPACE CENTER



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Use of products in the attached list of 13 aerosol spray adhesives, previously identified as banned by the Consumer Product Safety Commission (CPSC) in IS-MED-A memo to Distribution, same subject, dated September 11, 1973, is no longer prohibited at Kennedy Space Center.

The CPSC has lifted their ban on the listed 13 aerosol spray adhesives.

These materials will be removed from the "Toxic Materials Control List", identified in KHB 1840.1/IS, "Industrial Hygiene Handbook", Section VII, "Control of Toxic Materials", in the next revision to the KHB.

N. R. Koenig

Enclosure:  
Ban on Spray Adhesives Lifted

Distribution: STD-L-P

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CIRCULAR # 1

# BEN ON SPRAY ADHESIVES LISTED

## PRODUCT

## COMPANY

Foil Art Adhesive	3M Company
3M Brand Spray Adhesive 77	3M Company
Scotch Brand Spra-Ment Adhesive	3M Company
Krylon Spray Adhesive	Borden Company
Marshall's Photo Mount Spray Adhesive	Borden Company (Distributed by J. G. Marshall Manufacturing Company)
Sear's Multi-purpose Spray Adhesive	3M Company (sold by Sears, Roebuck, & Co.)
Scotch Brand Multi-purpose Spray Adhesive	3M Company
Scotch-Grip Brand Floral Adhesive 77	3M Company
3M Brand Shipping Mate Palletizing Adhesive	3M Company
3M Spray Trim Adhesive	3M Company
Tuff-Bond Spray-Hesive	3M Company (distributed by Goodloe E. Moore, Inc.)
Bear Brand Spray Trim Adhesive	3M Company (distributed by Norton Company)
Tri-Chem Spray Mist Adhesive	3M Company (distributed by Tri Chem, Inc.)

## PREFACE

The Industrial Hygiene Handbook provides general requirements for the implementation of the basic provisions of KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs". It outlines procedures and methods to be used in the recognition, evaluation, and control of those environmental factors and stresses arising in or from the workplace which may cause sickness, impaired health, or significant discomfort and inefficiency among workers in the performance of their daily tasks.

The provisions of this handbook are applicable to all organizational elements of the Kennedy Space Center (KSC), NASA, and to its associated contractors located at KSC, Cape Kennedy Air Force Station (CKAFS), and Vandenberg Air Force Base (VAFB) in accordance with the terms of their respective contracts.

Each section in this handbook is a complete entity and covers a separate item of interest in the Industrial Hygiene field. For convenience, each section also includes a list of references applicable to that section.

  
Frederic H. Miller  
Director of Installation Support

Distribution:  
STDL-P  
Special

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## REFERENCES

- KMI 1052.1A/TS, "KSC/AFETR Joint Operating and Support Agreement"
- KMI 1710.6/SF, "Decontamination, Neutralization, and Disposal of Toxic Propellants and Other Hazardous Liquids"
- KMI 1710.13A/SF, "Safety Review of KSC Technical Operating Procedures"
- KMI 1711.1A/SF, "Mission Failure Investigation Plan: Accident/Incident Reporting and Emergency Actions"
- KMI 1730.1C/SF, "Protective Clothing and Safety Equipment"
- KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs"
- KHB 400.1A/IS, "Supply Manual, Volume 1, KSC Supply System"
- K-V-053, Volume 1, Revision 5, "Apollo/Saturn (IB,V)/Skylab Ground Safety Plan-General Requirements"; KSC Industrial Safety SOP No. 4, "Tank Entry", and KSC Industrial Safety SOP No. 31, "Manhole Entry"
- SP 3410.1/AD, "Systems Training Course Catalog", OP-305KSC
- JOP 5401-H, "Joint Operating Procedure Between the Air Force Eastern Test Range and the John F. Kennedy Space Center for Environmental Pollution Control"
- NHB 1840.1, "A Guide to Hearing Conservation in Noise Exposure"
- NPD 1800.1, "NASA Occupational Medicine and Environmental Health Programs"
- NPD 1800.2, "Eye Conservation Program"
- Executive Order 11612, "Occupational Safety and Health Program for Federal Employees"
- Code of Federal Regulations, Title 29, Sections 1910.93c, 1910.95, 1910.97 and 1910.134
- American National Standard Practices for Respiratory Protection, Z88.2-1969
- Illuminating Engineering Society, IES Lighting Handbook, 4th Edition-1966

## SECTION I GENERAL DESCRIPTION

### 1.1 PURPOSE AND SCOPE

This handbook contains administrative direction and guidance on organizational and procedural requirements of the industrial hygiene portion of the Kennedy Space Center (KSC) Environmental Health Program. The program as identified in KMI 1810.1C/IS "KSC Occupational Medicine and Environmental Health Programs," consists of three elements:

- Industrial Hygiene
- Radiological Health
- Environmental Sanitation

Additional Industrial Hygiene elements (chemical, physical, ergonomic, etc.), not included in this handbook, will be developed and included herein at a later date.

Radiological Health guidance and procedural requirements are provided in KHB 1860.1, "Radiation Protection Handbook".

A handbook to cover Environmental Sanitation is being developed for issuance.

### 1.2 POLICY

KSC policy as expressed in KMI 1810.1C/IS is to provide an Environmental Health Program consistent with NASA directives, and the goals and objectives of Executive Order 11612 which calls for an effective and comprehensive environmental health program at all Federal installations.

### 1.3 AUTHORITY

Specific policy and instructions identified with the individual sections of this handbook are consistent with established policies set forth in NPD 1800.1 "NASA Occupational Medicine and Environmental Health Programs", KMI 1810.1C/IS "KSC Occupational Medicine and Environmental Health Programs", and Executive Order 11612, "Occupational Safety and Health Programs for Federal Employees".

## 1.4 APPLICABILITY

Provisions of this handbook apply to all NASA organizational elements at the Kennedy Space Center (KSC), Cape Kennedy Air Force Station (CKAFS), and Vandenberg Air Force Base (VAFB). Additionally, it applies to their supporting contractors in accordance with the provisions of their respective contracts.

## 1.5 ORGANIZATIONAL FUNCTIONS

- a. The Environmental Health Officer (IS-MED-A), prescribed by KMI 1810.1C/IS, (a member of the Medical Services Office, Installation Support Directorate), is responsible for administering the KSC Environmental Health Program to ensure that adequate guidance and assistance, recognition, monitoring, and control of physical, chemical, and biological hazards in the work environment are provided.

- b. Environmental Health Contractor

The Occupational Medicine and Environmental Health (OMEHS) Contractor performs environmental health engineering services for the identification, evaluation, and control of health hazards of stressful situations of work. He provides the following specific industrial hygiene elements:

- (1) Measurement and evaluation of toxic atmospheric contaminants.
- (2) Measurement and evaluation of harmful noise levels and their sources.
- (3) Surveys and studies of general ventilation and local exhaust equipment, and determination of their effectiveness.
- (4) Measurement and evaluation of quality and quantity of lighting.
- (5) Evaluation and analysis of heat, humidity, and cold stress.
- (6) Evaluation and analysis of hazardous effects of abnormal atmospheric pressure.
- (7) Monitoring and evaluating oxygen deficient atmospheres.
- (8) Studying and evaluating microwave and other radiant hazards.
- (9) Providing instructional training in industrial hygiene.

## SECTION II RESPIRATORY PROTECTION

### 2.1 PURPOSE AND SCOPE

- a. This section implements that portion of KMI 1810.1C/IS "KSC Occupational Medicine and Environmental Health Programs", as it relates to the reduction of occupational diseases caused by breathing contaminated air. It identifies requirements for the proper selection, acquisition, use, care, and maintenance of respirators as outlined in applicable Federal, State, and NASA regulations, policies, instructions, and guidelines. This section also offers a training course on respiratory protection that complies with the requirements of the Code of Federal Regulations, Title 29, Section 1910.134.
- b. The contents of this section are limited to those respiratory protective devices which use ambient air and rely primarily upon filters and/or chemical cartridges directly attached to the face mask (e.g., mask for a paint sprayer, dust, etc.). It does not apply to standard gas masks with detachable canisters or devices that use a compressed air or oxygen supply source.
- c. The purpose of this section is to afford all personnel with a safe, breathable atmosphere. When design engineering features cannot render the environment completely safe, the worker will be protected from airborne contaminants with suitable and approved respiratory protective devices.

### 2.2 ORGANIZATIONAL FUNCTIONS

- a. The KSC Environmental Health Officer (IS-MED-A) will:
  - (1) Review work plans and procedures to assess the need for respiratory protections.
  - (2) Provide assistance in selection of proper respiratory protective devices.
  - (3) Survey actual or potentially hazardous work areas and make recommendations to assure compliance with Federal, State, and NASA regulations, procedures, and policies in the control of atmospheric contaminants.

- (4) Present a training course, "Respirators - Selection, Use and Care" (OP-305KSC, SP 3410.1/AD Systems Training Course Catalog).
  - (5) Assuring that appropriate warning signs are placed in areas requiring respiratory devices.
- b. KSC Operating Officials will:
- (1) Ensure that KSC Environmental Health (IS-MED-A) is provided copies of work plans and procedures involving actual or potential atmospheric contamination prior to commencement of the work.
  - (2) Request assistance from the OMEHS Environmental Health Contractor in the selection of proper respiratory protection, if needed.
  - (3) Provide for the proper respirator and replacement components for each employee who will be exposed to atmospheric contamination. Requisitioning procedures contained in KHB 4000.1A, Volume 1, will be used to procure these items.
  - (4) Assure that the employee uses the respiratory protection furnished.
  - (5) Assure that employees are suitably trained in compliance with the provisions of Paragraph 2.3b of this section.

### 2.3 SELECTION AND USE OF RESPIRATORS

- a. The applicable Bureau of Mines approved respirator will be specified for each job, where appropriate. The type required will be specified in the work procedure. Selection will be made according to the guidance of American National Standard Practices for Respiratory Protection, Z88.2-1969.
- b. Immediate supervisory personnel and users will be instructed in selection, use, care, and maintenance as well as limitations to the use of respirators.
- c. Where practicable, respirators should be assigned to individuals for their exclusive use. Respirators not exclusively assigned will be thoroughly cleaned and disinfected prior to re-issue to another user.
- d. There shall be no planned activity for a contact lens wearer in a contaminated atmosphere. Where a contact lens wearer is working in an area that becomes contaminated, he will not be restricted from wearing a respirator during egress actions.

## 2.4 CLEANING PROCEDURE

### a. Frequency of Cleaning

The type of cleaning schedule for respirators depends on frequency and type of use. All respirators in use should at least be wiped out daily. Prolonged use in a dirty environment, use in spray painting, or use with certain pesticides would dictate a thorough cleaning at least once each day. Less severe use may permit less frequent thorough cleaning. However, all respirators in use shall receive a thorough cleaning at least once each week.

### b. Method of Thorough Cleaning

- (1) Remove the filters or cartridges and discard.
- (2) Wash the respirator thoroughly with an approved detergent in warm water (120°F).
- (3) Rinse completely in clean, warm water.
- (4) Air dry in a clean area set aside for that purpose.
- (5) Inspect valves, headstraps, and other parts; replace with new components if defective.
- (6) Insert new filters or cartridges and assure that the seal is tight.
- (7) Store in a clean, dry area or in a plastic bag.

## 2.5 DISINFECTION AND DECONTAMINATION PROCEDURES

- a. Disinfection of a respirator shall be accomplished through the use of an approved antibacterial spray. Spray the respirator thoroughly after cleaning and prior to replacement of filters or cartridges.
- b. Decontamination of a respirator following use with the application of phosphate pesticides shall be accomplished by rinsing in a 50 percent alcohol solution (ethyl or isopropyl) after cleaning and prior to replacement of filters or cartridges.

## 2.6 STORAGE OF RESPIRATORS

After cleaning, inspection and replacement of components, respirators shall be stored in a dry, dust-free environment and protected from sunlight and heat sources. Routinely used respirators may be placed in plastic bags for temporary storage, but those expected to remain in storage for extended periods should be placed in cartons to prevent crushing.

## 2.7 REFERENCES

- a. KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs".
- b. Code of Federal Regulations, Title 29, Section 1910.134.
- c. SP 3410.1/AD "Systems Training Course Catalog", OP-305KSC.
- d. American National Standard Practices for Respiratory Protection, Z88.2-1969.
- e. KHB 4000.1A/IS, "Supply Manual, Vol. 1; KSC Supply System".



## SECTION III HEARING CONSERVATION

### 3.1 PURPOSE AND SCOPE

- a. This section implements that portion of KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs", which pertains to the conservation of hearing.
- b. The contents of this section include extracts from Federal, State, and NASA regulations, policies, and procedures concerning acceptable sound levels in the work environment. Also included is a discussion of the effects of noise, how noise hazards are evaluated, and factors useful for effective noise control.

### 3.2 POLICY

It is the policy of the NASA as expressed in NPD 1800.1 that the hearing ability of all personnel will be conserved to the greatest extent practicable through engineering and/or administrative procedures designed to control or isolate hazardous sources of sound. Suitable ear protection will be provided for use in noise-hazard environments while engineering or administrative controls are being implemented, and for those employees working in noise-hazard areas not amenable to engineering control.

### 3.3 ORGANIZATIONAL FUNCTIONS

- a. The KSC Environmental Health Officer (IS-MED-A) will support hearing conservation by:
  - (1) Reviewing work plans and procedures to assess potential noise levels.
  - (2) Furnishing consultative services for the abatement of noise levels in new construction or when modifications are made to existing construction.
  - (3) Monitoring tests and work in progress to assess noise levels.
  - (4) Making recommendations to assure compliance with Federal, State, and NASA regulations, procedures, and policies for the control of noise and conservation of hearing.

- b. Contract Technical Managers will monitor contracts under their technical cognizance to ensure that they promote hearing conservation as part of their overall health program, and as prescribed by the terms of the contract.
- c. Supervisors, Civil Service and Contractors, at all levels will promote hearing conservation in accordance with the policy expressed in NPD 1800.1 and additionally by:
  - (1) Ensuring that IS-MED-A reviews work plans and procedures of operations that may produce hazardous noise levels.
  - (2) Controlling noise at the source, where feasible, through engineering means or procedures designed to isolate the source and applying appropriate administrative controls to exposed personnel.
  - (3) Complying with the provisions of the Code of Federal Regulations, Title 29, Section 1910.95 (refer to Paragraph 3.7, this section).
  - (4) Furnishing proper hearing protection for those employees exposed to hazardous noise levels, as outlined in NHB 1840.1 "A Guide to Hearing Conservation in Noise Exposure".
  - (5) Assuring that employees use the ear protection provided.
  - (6) Reporting levels of noise suspected of being in excess of 80 dBA to the OMEHS Contractor (853-3281), who will determine the actual dBA level.
  - (7) Assuring appropriate warning signs are placed in areas where the wearing of hearing protective devices is required.
- d. The KSC Medical Services Office (IS-MED) will support hearing conservation by:
  - (1) Conducting pre-placement audiometric examinations to establish baselines.
  - (2) Making annual audiometric examinations of personnel exposed to noisy environments.
  - (3) Evaluating all factors leading to discovered hearing loss, and making recommendations to prevent further damage.
  - (4) Assuring that ear defenders are properly fitted.

### 3.4 EFFECTS OF NOISE

- a. Noise is a form of energy and consists of rapid variations in atmospheric pressure that enter the external ear and create the sensation of hearing. Noise is unwanted sound. It can distract attention, annoy, startle, create fatigue, and interfere with speech. All of these affect performance and safety. More serious, noise levels in the 150 dB (decibel) range can create nausea, pain, and loss of muscular control. Most serious, continuous exposure to high intensity noises can lead to permanent loss of hearing.
- b. Noise induced permanent hearing loss is first evident in reduced ability to hear high frequencies. With further exposure, the reduction progresses to frequencies in the speech range. Sometimes, there are other symptoms such as buzzing or ringing in the ears even when away from the noise field.

### 3.5 EVALUATION OF NOISE

In a given work situation, a determination of the noise hazard involved requires consideration of many factors. Among these are:

- a. The character of the noise.
  - (1) Continuous or intermittent.
  - (2) Impact - impulse.
- b. The frequency components of the noise.
- c. The intensity of the noise.
- d. The length of exposure.

### 3.6 CONTROL OF NOISE

Every noise problem has three parts:

- A source of sound
- A path the sound must travel
- A receiver for the sound (the ear)

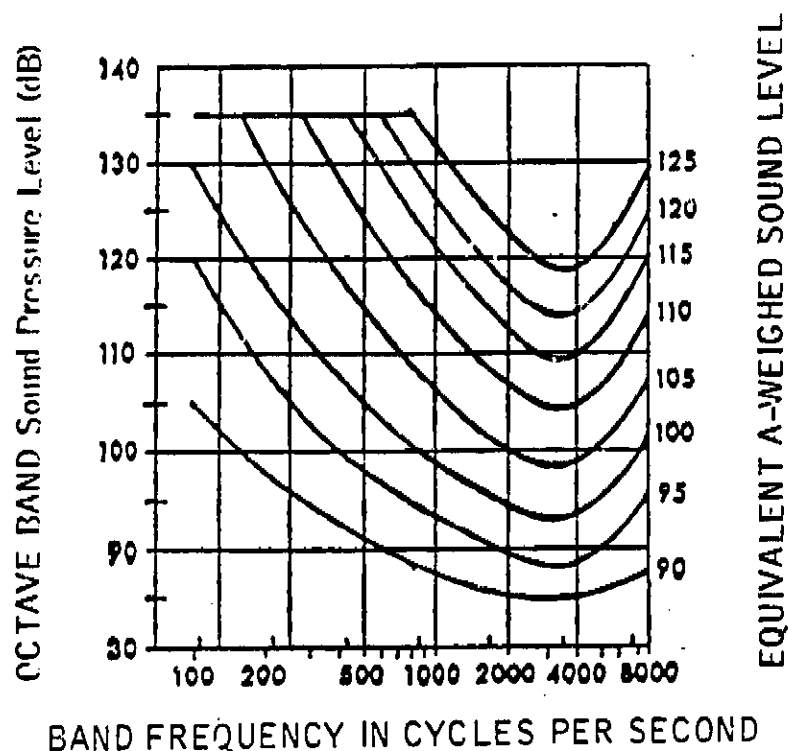
- a. Control at the source is achieved by:
  - (1) Modification
  - (2) Redesign
  - (3) Maintenance
- b. Control at the pathway is achieved by:
  - (1) Isolation at the source
  - (2) Baffles
  - (3) Acoustic absorption
- c. Control at the receiver is achieved by:
  - (1) Reduction of exposure time
  - (2) Personnel protection
  - (3) Enclosing the worker

### 3.7 OCCUPATIONAL NOISE EXPOSURE

The data listed below is extracted from CFR 29, 1910.95 "Code of Federal Regulations, Title 29, Section 1910.95".

- a. Protection against the effects of noise exposure shall be provided when the sound levels exceed those listed in Table 4-1, when measured on the A scale of a standard sound level meter at slow response.

When noise levels are determined by octave band analysis, the equivalent A-weighted sound level may be determined as follows:



Octave band sound pressure levels may be converted to the equivalent A-weighted sound level by plotting them on the graph, and noting the A-weighted sound level corresponding to the point of highest penetration into the sound level contours. This equivalent A-weighted sound level, which may differ from the actual A-weighted sound level of the noise, is used to determine the exposure limits from Table 4-1.

Table 4-1. Permissible Noise Exposures<sup>1</sup>

<u>DURATION</u> (per day, hours)	<u>SOUND LEVEL</u> (dBA slow response)
8 .....	90
6 .....	92
4 .....	95
3 .....	97
2 .....	100
1-1/2 .....	102
1 .....	105
1/2 .....	110
1/4 or less .....	115

1 When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions:  $C1/T1 + C2/T2 + Cn/Tn$  exceeds unity, then, the mixed exposure should be considered to exceed the limit value. ( $Cn$  indicates the total time of exposure at a specified noise level, and  $Tn$  indicates the total time of exposure permitted at that level.)

#### NOTE

Exposure to impulsive or impact noise should not exceed 140 dB peak sound level.

- b. (1) When employees are subjected to sound exceeding those listed in Table 4-1, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels to within the levels of Table 4-1, personal protective equipment shall be provided and used to reduce sound levels to within the prescribed levels.
- (2) If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous.
- (3) In all cases where the sound levels exceed the values shown herein, a continuing, effective hearing conservation program shall be administered as prescribed in Paragraph 3.3(d) of this section.

#### 3.8 REFERENCES

- a. KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs".
- b. Code of Federal Regulations, Title 29, Section 1910.95.
- c. NHB 1840.1, "A Guide to Hearing Conservation in Noise Exposure".
- d. NPD 1800.1, "NASA Occupational Medicine and Environmental Health Programs".

## SECTION IV CONTROL OF LASER HAZARDS

### 4.1 PURPOSE AND SCOPE

- a. This section implements KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs", as it pertains to the control of hazardous work environments.
- b. The contents of this section furnish information regarding the health hazards of highly energetic electromagnetic radiation associated with laser beams and describes safety practices and measures to control these hazards.

### 4.2 GENERAL

- a. Laser is defined as Light (infrared, visible, ultraviolet) Amplified by means of Stimulated Emission of Radiation.
- b. The values shown in Figure 4-1 will be used as planning guides in evaluating procedures and determining personnel hazard distances.

### 4.3 ORGANIZATIONAL FUNCTIONS

- a. The KSC Environmental Health Officer (IS-MED-A) will:
  - (1) Review written procedures prior to the use of a new laser system or use of an established system where operating mode, condition of use, or significant modification of any nature has occurred.
  - (2) Evaluate preliminary data received to determine potential health hazards using accepted health hazard criteria.
  - (3) Specify operating parameters to prevent hazards to health.
  - (4) Survey laser work areas for conformance with the requirements of Paragraph 4.4 and 4.5 of this section prior to use of the laser and periodically thereafter.
  - (5) Provide a Laser Hazard Training Program.
  - (6) Identify groups requiring ophthalmological examinations.

## EYE EXPOSURE

		Total <u>Energy</u> Entering Eye at the Level of the Cornea (microjoules)
RUBY	Long Pulse ( >1 ms) *	100
	Q-switched (1-100 ns)**	0.75

NEODYMIUM	Long Pulse ( >1 ms)	500
	Q-switched (1-100 ns)	45

### Total Power Entering Eye at the Level of the Cornea (milliwatt)

ARGON	cw (10 ms - 1 s)***	5
	cw ( 1 ms - 10 ms)	10
	( <1 ms)	20

HELIUM-NEON	cw (10 ms - 1 s)	5
	cw ( 1 ms - 10 ms)	10
	( <1 ms)	20

### Power Density Presented to the Eye at the Level of the Cornea (watts/square centimeter)

CARBON DIOXIDE	cw (50 - 250 ms)	1
	cw (10 - 50 ms)	3
	(<10 ms)	8

Legend: \* ms = milliseconds  
\*\* ns = nanoseconds  
\*\*\* s = seconds

### Note:

For all other lasers, planning guides will be developed by the OMEHS Environmental Health Contractor in coordination with the Environmental Health Officer.

## SKIN EXPOSURE

For lasers operating in the visible spectrum (380 - 750 nm):

Pulsed mode	0.1 joule/cm <sup>2</sup> /pulse with pulse repetition rate less than 1000 pulses/second
Continuous wave	1 watt/cm <sup>2</sup> for 10 seconds

### Note:

For all other lasers, skin exposure levels should be considered the same as those established for the eye exposure.



b. The Director, KSC Safety Office (SF) will:

- (1) Review operating procedures for new and modified laser systems to ensure compliance with safety requirements.
- (2) Conduct periodic safety surveys of laser work areas to ensure compliance with Paragraphs 4.4 and 4.5 of this section.
- (3) Specify appropriate personnel safety equipment.
- (4) Provide assistance in the Laser Hazards Training Program.

c. Organizations using lasers will:

- (1) Submit a written procedure to KSC Environmental Health and KSC Safety prior to the use of a new or modified laser system. The procedure will be submitted at least 30 days prior to use and will incorporate the following information as well as requirements designed to comply with safeguards listed in Paragraphs 4.4 and 4.5 of this section.

- (a) Laser type
- (b) Wavelength
- (c) Mode of operation
- (d) Power (watts) or energy in joules
- (e) Beam diameter
- (f) Beam divergence
- (g) Pulse length
- (h) Pulse repetition rate
- (i) Associated equipment
- (j) Calibration procedure
- (k) Date of initiation and projected duration of the program
- (l) A list of personnel involved in the program

- (2) Ensure that safe laser operating parameters are followed as specified in the preliminary report.
- (3) Assure that all personnel involved in laser operations are properly indoctrinated in all hazardous aspects of the operation.
- (4) Comply with the provisions of Paragraph 4.7 as regards accidents/incidents involving the use of lasers.

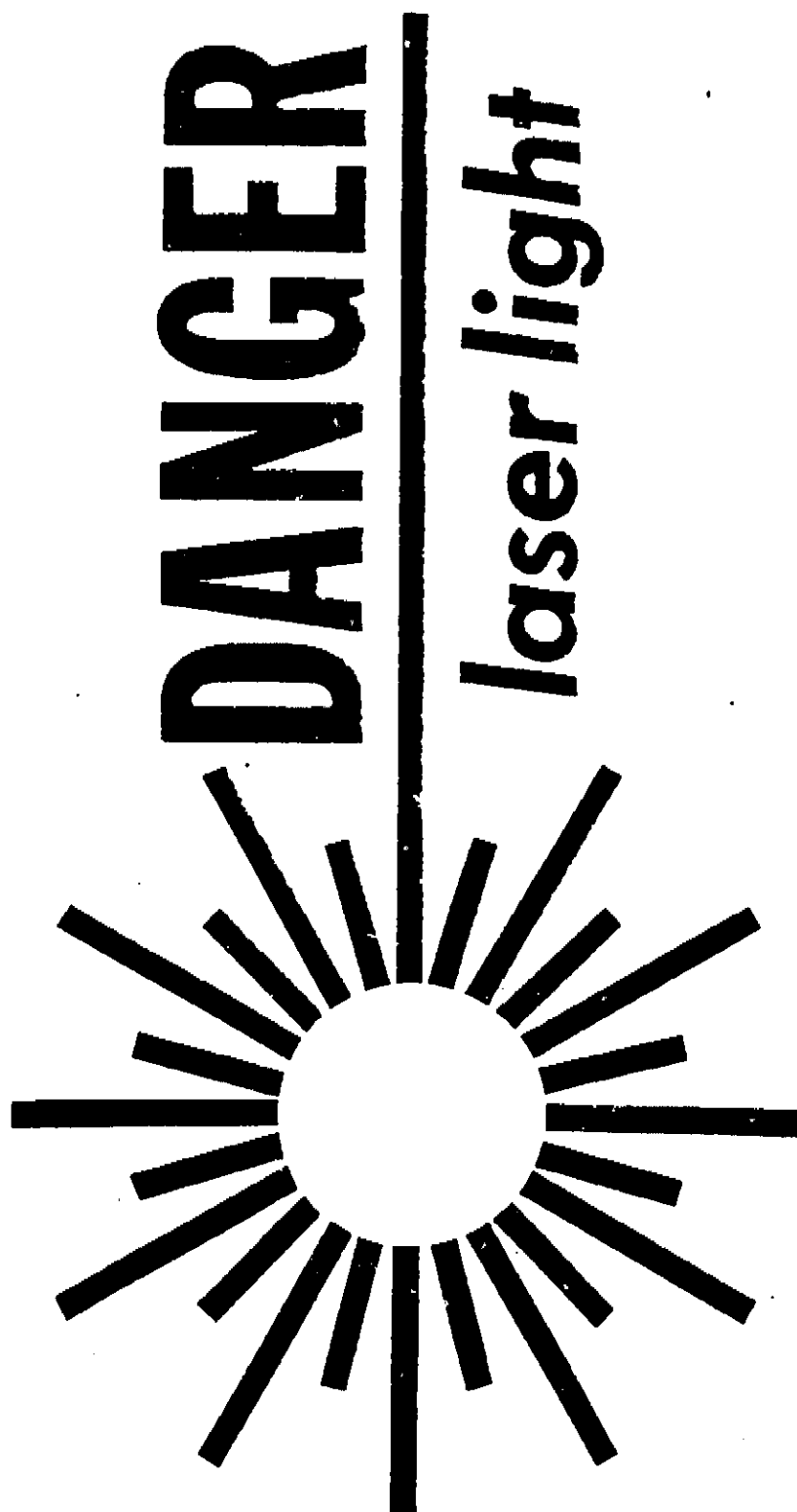
#### 4.4 LASER WORK AREA REQUIREMENTS

- a. Work areas shall be well lighted except where this would severely impair mission accomplishment.
- b. All electrical equipment shall be properly grounded.
- c. All high voltage sources shall be shielded. Shields shall have interlocks to prevent access to energized components.
- d. If high voltage rectifiers (over 15 kV) are used, special precautions shall be taken to avoid potential exposure to x-rays.
- e. Combustible solvents and materials shall be stored in approved conditions.
- f. Food and beverages shall not be allowed in laser work areas.
- g. Good housekeeping shall be practiced at all times.
- h. Laser work areas shall be classified as limited access areas.
- i. "Laser Hazard" warning signs conforming to the design in Figure 4-2 shall be used to identify designated hazardous laser areas.
- j. In addition to the above, when any Q switched pulse mode laser with an energy density greater than  $0.07 \text{ J/cm}^2$ , a non-Q switched pulse mode laser with an energy density greater than  $0.9 \text{ J/cm}^2$ , or a continuous wave laser with a power density greater than  $2.5 \text{ W/cm}^2$  is used, these work area precautions will also be observed:

- (1) Visible surfaces in the work area will be of non-reflective or matte finish to preclude specular reflections.
- (2) Measures will be taken to prevent injury from inadvertent discharge of capacitors, if applicable.
- (3) Installations using liquid gas coolant or where vaporization of toxic metal may occur, shall be adequately ventilated.

#### 4.5 LASER OPERATING PRECAUTIONS

- a. Laser systems employing water for cooling shall be checked for leaks prior to electrical activation.
- b. Where specified, shatter-resistant safety glasses or goggles of an appropriate density will be worn.
- c. Avoid looking into the beam or at specular reflections of the beam.
- d. Avoid aiming the laser with the eye.
- e. The laser beam shall terminate on a non-reflective and fire resistant material, if feasible.
- f. Limiting stops shall be used on lasers to prevent movement of the beam into occupied areas.
- g. If possible, laser operations shall be conducted away from heavily populated or occupied areas.
- h. In addition to the above, when any laser exceeds the energy densities outlined in Paragraph 4.4j of this Section, these operating precautions will also be observed:
  - (1) A warning light will be provided at each entrance to the laser area and activated to restrict entry during laser operations. Appropriate warning signs (see Figure 4-2) will be used in conjunction with the warning light.
  - (2) Lasers shall be operated using closed circuit TV when feasible. An alternative is to enclose the laser and beam in a light-light interlock box.



NOTE: Symbol (starburst) and Border usually are red on white background -- Letters are black  
(Actual wording and overall size may vary, as required, for specific needs)

Figure 4-2. Laser Hazard Warning Sign (Sample)

- (3) If necessary to view the work piece while the laser is energized, closed circuit TV, an optical comparator with appropriate filters, or a microscope with appropriate shutters will be used.

#### 4.6 LASER MAINTENANCE PRECAUTIONS

- a. Only personnel qualified by training in laser maintenance shall be permitted to work on laser systems.
- b. No maintenance will be performed on laser systems until the power source is "off" and residual charges of capacitors drained.
- c. Power switches physically separated from the equipment shall be locked out and tagged prior to maintenance operations.
- d. The eye will not be used to align the laser beam during maintenance.

#### 4.7 LASER ACCIDENT /INCIDENT REPORTING

- a. The Program Engineer in charge of each laser system will report all laser beam skin injuries as well as real or suspected laser beam eye exposures to the Safety Office in accordance with the requirements of KMI 1711.1A/SF, "Mission Failure Investigation Plan: Accident/Incident Reporting and Emergency Actions".
- b. In addition, personnel affected as in Paragraph a. above and those who experience persistent after-images following laser operations, will be sent to the Occupational Health Facility (OHF) for medical evaluation.
- c. The Occupational Medicine and Environmental Health Services (OMEHS) contractor will provide a written assessment of reported laser beam accidents/incidents to the KSC Environmental Health Officer (IS-MED-A).

#### 4.8 MEDICAL SURVEILLANCE PROGRAM

All personnel whose duties require their routine or frequent presence within the minimum safe distance of a laser system, as determined by KSC Environmental Health (IS-MED-A), will be placed in a medical surveillance program conducted by the Occupational Medicine and Environmental Health Services (OMEHS) contractor in accordance with the provisions of KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs". This program will, as a minimum, consist of a baseline, periodic, and termination ophthalmological examination. Additional test will be done at the discretion of the Clinic Director as approved by the Chief, Medical Services Office (IS-MED).

#### 4.9 REFERENCES

- a. KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs".
- b. KMI 1711.1A/SF, "Mission Failure Investigation Plan: Accident/ Incident Reporting and Emergency Actions".

## SECTION V CONTROL OF MICROWAVE RADIATION

### 5.1 PURPOSE AND SCOPE

- a. This section implements KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs", as it applies to the control of microwave radiation at KSC. This section does not apply to laser operations covered in Section IV.
- b. This section describes the KSC Non Ionizing Radiation Control Program (for microwave radiation) which includes guidelines for controlling and minimizing exposure to microwave radiation. It applies to all who possess, use, or handle devices within the confines of KSC, which are capable of producing hazardous levels of microwave radiation to personnel.

### 5.2 GENERAL

- a. Microwave radiation includes that portion of the electromagnetic spectrum (Figure 5-1) between wavelengths of 0.1 mm and 2 m.
- b. The major biological effect of microwave radiation is thermal damage resulting from absorption of the microwave radiation. Physiological alterations produced by elevating the body temperature by absorption of microwave radiation are indistinguishable from changes produced by fever or temperature increases of any origin. However, in the area of nonthermal effects, it is suggested that there is a direct interaction between the microwave radiation and the central nervous system. Intense exposures for sufficient periods of time can produce biological effects including cellular disintegration and destruction of enzymes and other molecules of biological importance.
- c. The accepted safe limit for microwave exposure is 10 milliwatts per square centimeter. Equipment producing less than this quantity does not come under the purview of this handbook.
- d. RF power sources with average power outputs as low as 1 milliwatt (0dbm) may produce RF fields in waveguides approaching a power density of 10 milliwatts per square centimeter. Personnel should therefore not look into the open end of any waveguide assembly when it is fed RF power.

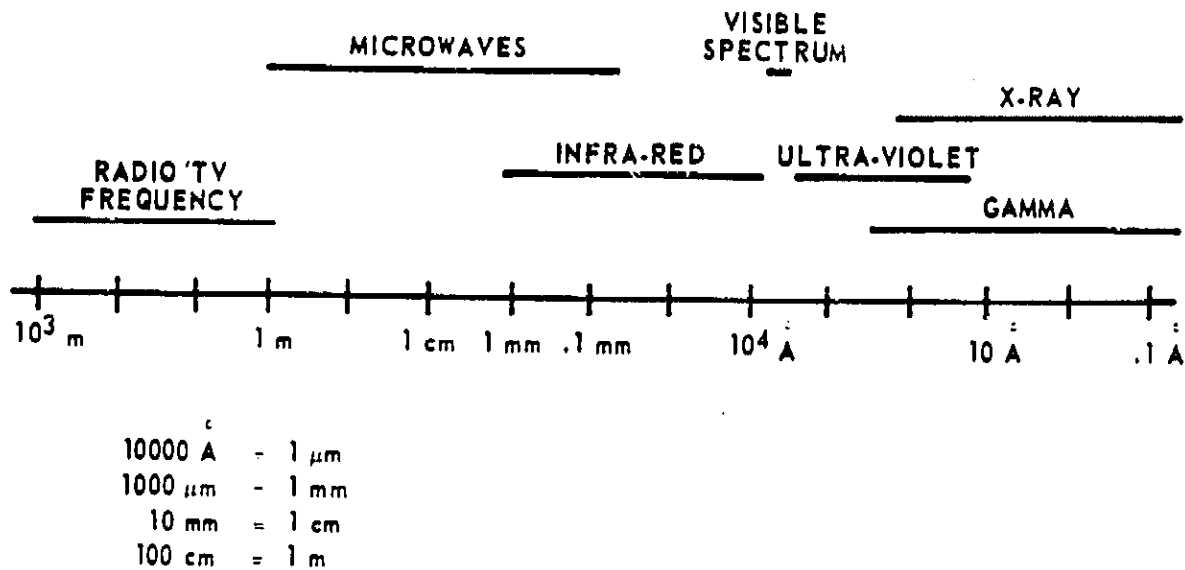


Figure 5-1. The Electromagnetic Spectrum

### 5.3 ORGANIZATIONAL FUNCTIONS

- a. The KSC Environmental Health Officer (IS-MED-A) will:
- (1) Review written instructions and procedures applicable to microwave devices.
  - (2) Review plans for siting, construction, modification, and operation of microwave devices.
  - (3) Provide consultation services to all organizations utilizing microwave devices at KSC.
  - (4) Evaluate the health hazards associated with the use of each microwave installation.
  - (5) Establish, in coordination with the project engineer in charge, temporary operating restrictions if potential hazards exist during testing of new or modified microwave devices.
  - (6) Maintain a locator list of microwave systems capable of producing hazardous levels of radiation.



- (7) Perform initial and follow-up surveys of each system when one or more of the following conditions occur:
    - (a) Change in power output
    - (b) Modification of radiated beam geometry
    - (c) Suspected leakage around transmitters and wave guides
    - (d) Placement of new structures within the 10 mw/cm<sup>2</sup> hazard distance
    - (e) Relocation or change of system antenna
  - (8) Establish a Medical Surveillance Program of personnel potentially exposed to average power densities greater than 10 mw/cm<sup>2</sup>. Inclusion of baseline, periodic and termination examinations in this program will be at the discretion of the OMEHS Clinic Director, as approved by the Chief, KSC Medical Services Office (IS-MED).
  - (9) Investigate all accidents/incidents involving microwave radiation.
  - (10) Perform inspections to assure that appropriate warning signs are posted in all potentially hazardous areas.
  - (11) Monitor microwave procedures established at KSC.
- b. Organizations who site, construct, modify, or operate systems or devices capable of producing hazardous microwave radiation will:
- (1) Comply with the Code of Federal Regulations, Title 29, Section 1910.97.
  - (2) Submit four copies of plans and the information listed below to the KSC Environmental Health Officer (IS-MED-A) prior to siting, construction, modification, or operation of microwave-producing devices:
    - (a) System drawings, and site plans showing location, building and antenna dimensions, heights above sea level, location of system components, adjacent area, or facilities, and required antenna orientation.

(b) Information concerning operating parameters, such as:

1. Transmitter peak power
2. Pulse widths
3. Pulse repetition frequencies
4. Pulse codes
5. Maximum rated duty cycle
6. Size and type of antenna
7. Antenna gain and illumination
8. Beam width and skew
9. Operating frequency
10. Insertion loss between transmitter and antenna
11. Polarization of transmitted wave

(c) Date construction or modification is expected to start and expected completion date.

- (3) Comply with preliminary hazard restrictions established by the KSC Environmental Health Officer (IS-MED-A).
- (4) Notify the KSC Environmental Health Officer (IS-MED-A), the OMEHS contractor, and KSC Safety (SF) immediately in the event of an incident or an accident involving microwaves.
- (5) Identify and control potentially hazardous microwave areas.
- (6) Assure that approved microwave hazard warning signs are posted in potentially hazardous areas.

#### 5.4 CONTROL OF MICROWAVE OVENS

- a. Organizations owning or using microwave ovens will register this equipment with the OMEHS contractor.
- b. Locations or changes of locations shall be reported by tag or serial number.
- c. All microwave ovens to be used at KSC will be surveyed for leakage at the time of installation and monthly thereafter.
- d. Damaged and repaired ovens will be resurveyed for leakage prior to use.
- e. Requests for surveys are to be submitted directly to the OMEHS contractor.
- f. Signs reading, "Warning to Pacemaker Patients - Microwave Oven      Feet Ahead" shall be posted at all access routes to microwave ovens. It is desirable to warn pacemaker patients at least 10 feet from the device.

#### 5.5 REFERENCES

- a. KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs".
- b. Code of Federal Regulations, Title 29, Section 1910.97.

## SECTION VI LIGHTING

### 6.1 PURPOSE AND SCOPE

This section of the KSC Industrial Hygiene Handbook implements the instructions contained in KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs", as it pertains to adequate light levels in the work area. The contents are limited to non-ionizing radiation in the visual range. Optical hazards associated with the use of lasers are covered in Section IV of this Handbook.

### 6.2 POLICY

It is the policy of the NASA as expressed in NPD 1800.2 to maintain an aggressive program of eye conservation which includes the conducting of periodic surveys of all worksites as a basis for assessment and correction of any environmental factor that may damage or impair the employees eyesight.

### 6.3 PROCEDURES

- a. The KSC Environmental Health Officer (IS-MED-A) will:
  - (1) Provide consultation for the determination of proper light levels in proposed work areas.
  - (2) Perform illumination surveys to assure adequate, safe, light levels in all work areas.
  - (3) Make recommendations through proper channels to assure that light levels in work areas comply with Federal, State, and NASA requirements.
  - (4) Follow-up on previously made recommendations to assure compliance with (3) above.
- b. The KSC Medical Services Office (IS-MED) acting through the OMEHS medical contractor will:
  - (1) Provide for appropriate eye examinations on all pre-placement, periodic, and special certification physical examinations.

- (2) Provide special eye pathology screening as a part of preventive health care.
  - (3) Evaluate the visual capability of workers whose jobs require specific visual capabilities.
- c. Contract Technical Managers and Supervisors at all levels will:
- (1) Assure that action is taken to correct unsatisfactory lighting conditions (as determined from illumination surveys conducted by IS-MED-A).
  - (2) Furnish suitable eye protection for employees exposed to high intensity light sources when such sources cannot be controlled through engineering design, as outlined in KMI 1730.1C, "Protective Clothing and Safety Equipment".

#### 6.4 RECOMMENDED LIGHTING LEVELS

For convenience, a representative listing of recommended lighting levels is presented. This listing has been extracted from the Fourth Edition, 1966, of the IES Lighting Handbook published by the Illuminating Engineering Society. These levels are based on the visual requirements of young adults with normal vision. It should be understood that the desirable amount of light, regardless of the location, depends upon the type of work being done in that location.

<u>Area</u>	<u>Footcandles on Task</u>
Assembly - Medium Size	100
Auto Repair	100
Building - Entrance	5
Inspection - Difficult	100
Locker Room	20
Machine Shop - Rough Work	50
Machine Shop - Medium	100
Office - Accounting	150
Office - Regular	100
Office - Drafting	200
Warehouse	10 - 20

## 6.5 REFERENCES

- a. KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs".
- b. KMI 1730.1C, "Protective Clothing and Safety Equipment".
- c. NPD 1800.2 "Eye Conservation Program".
- d. IES Lighting Handbook, Illuminating Engineering Society, Fourth Edition, 1966.

## SECTION VII CONTROL OF TOXIC MATERIALS

### 7.1 PURPOSE AND SCOPE

This section implements that portion of KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs", as the KMI related to the control of toxic materials, and KMI 1710.6/SF, "Decontamination, Neutralization, and Disposal of Toxic Propellants and Other Hazardous Liquids". This section establishes controls for minimizing the hazard to health of personnel and damage to the environment in the procurement, handling, storage, use, and disposition of toxic materials.

### 7.2 ORGANIZATIONAL FUNCTIONS

a. The KSC Environmental Health Officer (IS-MED-A) will:

- (1) Maintain a Toxic Materials Control List.
- (2) Designate materials to be placed on the Toxic Materials Control List.
- (3) Provide consulting services in the selection, use, treatment, and disposal of all toxic materials at KSC.
- (4) Review and approve procedures for use and disposal of toxic materials.
- (5) Conduct surveys to assure compliance with established policies and procedures in the control of toxic materials.
- (6) Investigate accidents and incidents involving toxic materials.

b. KSC operating officials will:

- (1) Ensure that a current inventory is maintained of all toxic materials in their organizational elements.
- (2) Provide Environmental Health with accurate information of composition and quantity of toxic materials destined for disposal to

ensure that safe disposal procedures are utilized. Procedures contained in KHB 4000.1A/IS, Volume I, Section 9, Chapter 1, will be used to dispose of excess/surplus property items listed in paragraphs 7.3 and 7.4 of this Section. Disposal procedures, where applicable, will be consistent with JOP 5401-H on Environmental Pollution Control which is contained in KMI 1052.1A/TS.

- (3) Assure that all procedures designed for safe use and disposal of toxic materials are coordinated with and approved by Environmental Health prior to implementation.

### 7.3 TOXIC MATERIALS CONTROL LIST

- a. The following is a representative listing of known toxic materials used at KSC which require controls on procurement, storage, use, and disposition. The applicability of controls to materials not listed can be determined by KSC Environmental Health:

Aldrin

Ammonium phosphate

Aniline

Aprocarb, Baygon<sup>R</sup> (Chemgro)

Arsenic and arsenic compounds

Asbestos

Benzene

Beryllium and beryllium compounds

Cadmium

Carbaryl

Carbon tetrachloride

Chlordane

Chlorine

Chlorobromomethane

Chromates



Coal tar  
Cobalt  
Cyanide(s)  
DDT  
Diazinon  
Dieldrin  
Diphenyl  
Diphenylmethane diisocyanate (MDI)  
Ethylene Oxide  
Formaldehyde  
Furfuryl Alcohol  
Gallium and gallium compounds or alloys  
Hydrofluoric Acid  
Hydrogen Peroxide  
Hydrogen Sulfide  
Hypergolic propellants (disposal control only)  
(i.e.,  $N_2O$ , IR.FNA,  $N_2H_2$ , MMH, Aerozine-50, UDMH, etc.)  
Lead and lead compounds  
Malathion  
Mercury and mercury compounds  
Methyl alcohol  
Methyl chloride  
Naled, Dibrom<sup>R</sup> Chevron  
Normal superphosphate  
Parathion  
Perchloroethylene  
Phosphoric acid  
Phthalic anhydride  
Potassium hypochlorite  
Pyrethrin

Sodium hypochlorite

Tellurium

TEPP

Tetrahydrofuran

Thallium

Toluene

Toluene diisocyanate (TDI)

Trichlorethane

Trichloroethylene

All new pesticides or pesticides not previously used

Additional items as determined by KSC Environmental Health

- b. The following products contain a known carcinogen in excess of 1% by weight as outlined in Code of Federal Regulations, Title 29, Section 1910.93C. These items will not be procured, issued, or used without evidence of an approved procedure for their use signed by the Environmental Health Officer (IS-MED-A) and KSC Safety (SF).

Crest 7139, Crest Products

Curalon M, Uniroyal Chemical

Curene 442, Anderson Development

Cyanaset, American Cyanamid

DPM 2509 Series, McDonnell Douglas (Products Research & Chemical) PR 1535

DPM 3363 Series, McDonnell Douglas (Products Research & Chemical) PR 1538

DPM 8396, McDonnell Douglas (3M) EC 3515 or (Stabond) Stabond U-135

DPM 4312, McDonnell Douglas (Products Research & Chemical  
PR 1532

EC 3515, 3M Company

Moca, E. I. DuPont

PC-22, Hysol

Polyurathane 7139, Whittiker, Narmco Division

PR 1532, Products Research & Chemical

PR 1535, Products Research & Chemical

PR-1538, Products Research & Chemical

PR-1538c, Products Research & Chemical

Pro-Seal 794, Teledyne Coast Pro-Seal

Stabond U-135, Stabond

Uralane 5712-B, Furane Plastics

- c. The following is a listing of spray adhesives, banned by the Federal Consumers Product Safety Commission (CPSC), that have exhibited evidence of causing chromosome damage. Issuance and use of these products is not approved at KSC:

Foil Art Adhesive, 3M Company

3M Brand Spray Adhesive 77, 3M Company

Scotch Brand Spra-Ment Adhesive, 3M Company

Krylon Spray Adhesive, Borden Company

Marshall's Photo Mount Spray Adhesive, Borden Company  
(Distributed by J. G. Marshall Manufacturing Company)

Sear's Multi-purpose Spray Adhesive, 3M Company (Sold by  
Sears, Roebuck, & Company)

Scotch Brand Multi-purpose Spray Adhesive, 3M Company

Scotch-Grip Brand Floral Adhesive 77, 3M Company

3M Brand Shipping Mate Palletizing Adhesive, 3M Company

3M Spray Trim Adhesive, 3M Company

Tuff-Bond Spray-Adhesive, 3M Company (Distributed by Goodloe E. Moore, Inc.)

Bear Brand Spray Trim Adhesive, 3M Company (Distributed by Norton Company)

Tri-Chem Spray Mist Adhesive (11 oz. can only), 3M Company  
(Distributed by Tri-Chem, Inc.)

#### 7.4 MANUFACTURED ITEMS CONTAINING TOXIC MATERIALS THAT REQUIRE PROCUREMENT AND/OR DISPOSAL CONTROL

- \*\*Battery, Air Cell
- \*\*Battery, Alkaline, Zn-MnO
- \*\*Battery, "Dry cell", Zn-MnO<sub>2</sub> (Le Clanche)
- Battery, Mercury
- \*\*Battery, Standard pb, Hg
- \*\*Dials, Luminescent
- Electrode, Calomel
- \*\*Lamp, Fluorescent
- \*\*Lamp, Mercury vapor
- Manometers, Mercury
- Rectifier, Mercury vapor
- Relay, Mercury
- \*\*Switch, Mercury
- \*\*Thermometer, Laboratory (Hg)
- \*\*Thermometer, Clinical (Hg)
- Thermometer, Hg-filled
- \*\*Paint, Non-fouling (Hg)
- \*\*Paint, Mildew-resistant (Hg)
- Paint, Containing more than 0.01 lbs. Hg or 1% by weight

NOTE: \*\*Require Disposal Control Only

## 7.5 REFERENCES

KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs".

KMI 1710.6/SF, "Decontamination, Neutralization, and Disposal of Toxic Propellants and Other Hazardous Liquids".

KHB 4000.1A/IS, "Supply Manual, Volume I, "KSC Supply System".

KMI 1052.1A/TS, "KSC/AFETR Joint Operating and Support Agreement".

JOP 5401-H, "Joint Operating Procedure Between the Air Force Eastern Test Range and the John F. Kennedy Space Center for Environmental Pollution Control".

Code of Federal Regulations, Title 29, Paragraph 1910.93c.

## SECTION VIII TANK AND CONFINED SPACE ENTRY

### 8.1 PURPOSE AND SCOPE

This section implements that portion of KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs," as it pertains to ventilation and toxic atmospheric contaminants. It identifies requirements and guidelines to be utilized for tank and confined space entry operations.

### 8.2 GENERAL

a. An understanding of the following terms is pertinent to the implementation of this section.

- (1) Tank and Confined Space: An area which may contain a hazardous atmosphere or by virtue of its use or physical character may be oxygen deficient. (This includes tanks, pits, ducts, sewers, tunnels, compartments, and manholes.)
- (2) Lower Explosive Limit (LEL): The minimum concentration of gas or vapor in air or oxygen which, if ignited, will propagate flame independently of an external ignition source.
- (3) Threshold Limited Value (TLV): The air concentration of a toxic material to which the average worker may be exposed 8 hours per day over extended periods of time without apparent injurious or deleterious health effect.

b. Tank and Confined Space atmosphere will be classified as follows:

- (1) Class "A": Oxygen content is about 19.5 percent and vapor concentrations are less than the TLV listed in the latest list published by the American Conference of Governmental Industrial Hygienists\* and flammable or explosive vapor concentrations are less than 25 percent of the LEL.

\*To provide a guide, "Threshold Limit Values", as published annually by the American Conference of Governmental Industrial Hygienists is hereby adopted in its entirety. Each year, as they are updated, the Values will be adopted, and those of the preceding year will be rescinded.

- (2) Class "B": Oxygen content is 19.5 percent or lower and/or toxic vapor concentrations are more than the TLV. Flammable vapors at concentrations greater than 25 percent of the LEL may also be present.

### 8.3 ORGANIZATIONAL FUNCTIONS

- a. The KSC Environmental Health Officer (IS-MED-A) will:
  - (1) Maintain a file on Threshold Limit Values and be responsible for interpreting and applying these values to KSC operations.
  - (2) Review plans and procedures on "Tank and Confined Space Entry" to assure environmental health adequacy.
  - (3) Provide monitoring for tests and work in progress to assess atmospheric conditions of tanks and confined spaces. Response will be 30 minutes during normal duty hours (0730-1630 Monday through Friday) and 2 hours during off-duty hours.
  - (4) Provide instruction and guidance on tank and confined space entry.
  - (5) Approve respiratory equipment to be used in tank and confined space entry.
  - (6) Establish training standards for the use of atmospheric measuring equipment applicable to the measurement and detection of toxic and combustible gases.
- b. Supervisory personnel or organizations having a need to enter tanks or confined spaces will:
  - (1) Submit a specific procedure listing the precautions which will be taken during such entry operations. The procedure must be based upon the criteria set forth in KMI 1710.13/SF and this section. It must be reviewed and approved by the KSC Safety Office and the KSC Environmental Health Officer.
  - (2) Ensure that approved safe-operating procedures and the requirements of paragraphs 8.4 and 8.5 are followed.
  - (3) Ensure that involved personnel have received proper training in "Tank and Confined Space Entry".

#### 8.4 PRE-ENTRY REQUIREMENTS

- a. Before any entry is attempted, the condition of the atmosphere in the tank or confined space must be determined. The supervisor responsible for the personnel performing the entry must assure that this is accomplished. This check will include tests for oxygen content, toxic gases, and flammable vapors; and the person making the check will complete the sign Part 1 of Entry Permit (KSC Form 16-297, see Figure 8-1).
- b. Based on the condition of the tank or confined space, appropriate safety equipment will be made available by the supervisor of the Tank Entry Crew.
  - (1) For Class "A" Atmosphere: Constant purging with fresh or certified breathing air will assure that the atmosphere remains essentially the same, and periodic rechecks will verify this fact. If the tank or confined space is left unattended for more than 8 hours a recheck of the tank atmosphere will be made and a new permit issued. Approved breathing equipment will be available on a standby basis near the tank or confined space entrance. Someone outside must be aware of the operations therein and must take periodic checks to assure that no problems develop in the tank or confined space. The time interval between atmospheric checks shall not exceed 2 hours during tank or confined space occupancy.
  - (2) For Class "B" Atmosphere:
    - (a) Personnel must be equipped with an approved safety harness and approved respiratory protective equipment. A lifeline must be attached to each safety harness and it must be tended by someone at the Access opening. Verification should be made to ensure that the manway will accommodate an unconscious person being removed with a life line.
    - (b) Lines used to supply breathing air will be connected direct to the air supply source. Under no circumstances will lines be "jury-rigged" through a plumbing system or a valve cabinet of a gas media other than air. Lines used for transmission of breathing air will be tagged at all connections indicating that they are not to be disconnected. Purge line(s) should enter the area opposite the tank or confined space opening or, if this is impractical, line(s) should be extended within the area to the opposite extremity from the opening to assure the most effective purge.





- c. Before any personnel are allowed to enter the tank or confined space, the supervisor in charge of the entry personnel will see that proper safety equipment is on hand and all personnel involved are thoroughly familiar with the operation they are to accomplish, the inherent hazards, and the safety equipment they are to use. He will further personally inspect all safety gear to be certain it is in good working order and will complete Part 2 of the Entry Permit (Figure 8-1).
- d. The completed permit must be available for inspection at the tank or confined space access at all times while anyone is in the spaces. Only the operations specified in Part 2 of the Entry Permit will be allowed. If different operations must be accomplished, a new permit must be prepared.
- e. The Occupational Medicine and Environmental Health Contractor (853-3281) will be called upon for an evaluation of tank and confined space conditions if any quantities of flammable or toxic gases are detected. They will complete and sign Part 3 of the Entry Permit (Figure 8-1).

#### 8.5 ENTRY REQUIREMENTS

- a. The Occupational Medicine and Environmental Health contractor (853-3281) will monitor all entry operations involving Class B atmospheres and complete and sign Part 3 of the Entry Permit (Figure 8-1).
- b. Entry into Class "A" atmospheres will not be permitted until the space has been purged with fresh or certified breathing air for a minimum of 15 minutes at a minimum purge rate of 500 cfm.
- c. Smoking or open flame devices will not be permitted in the vicinity of an open tank or confined space until a safe atmosphere has been positively determined.
- d. When temperature is questioned, a specific evaluation will be obtained from the OMEHS Environmental Health Contractor.
- e. If flame devices are allowed to be used, a permit will be obtained from Fire Service.
- f. Proper voice and visual communications will be constantly maintained between personnel inside the tank and those supporting on the outside.

g. Applicable Safety Documentation:

- (1) Industrial Safety SOP 31 (K-V-053, Vol I, Rev. 5, "Manhole Entry").
- (2) Industrial Safety SOP 4 (K-V-053, Vol I, Rev. 5, "Tank Entry").
- (3) KMI 1710.13A/SF, "Safety Review of KSC Technical Operating Procedures".

8.6 EMERGENCY PROCEDURE

If a person becomes ill, injured, or otherwise incapacitated while inside the tank, or confined space, proceed as follows:

- a. Remove the person from the tank using appropriate safety gear and procedures.
- b. Summon medical help.
- c. Render first aid.
- d. Notify Fire Service if rescue equipment and personnel are required.
- e. Suspend or terminate the operations.
- f. Notify KSC Safety.
- g. Do not resume operations until the area is declared safe by Fire Service, KSC Safety, and OMEHS Environmental Health.

8.7 EMERGENCY NUMBERS

Medical	867-2222
Safety	867-4317
Fire	117
OMEHS Environmental Health	853-3281
Security	867-2121

## 8.8 ACCIDENT/INCIDENT REPORTING

Accidents and incidents will be reported to the KSC Safety Office in accordance with the requirements of KMI 1711.1A/SF "Mission Failure Investigation Plan: Accident/Incident Reporting and Emergency Actions", and KHB 1711.1/SF, "Investigation and Reporting Handbook for Accidents, Incidents, and Mission Failures".

## 8.9 REFERENCES

- a. KMI 1711.1A/SF, "Mission Failure Investigation Plan: Accident/Incident Reporting and Emergency Actions".
- b. KMI 1710.13A/SF, "Safety Review of KSC Technical Operating Procedures".
- c. KMI 1810.1C/IS, "KSC Occupational Medicine and Environmental Health Programs".
- d. KSC Industrial Safety SOP No. 4, (K-V-053, Vol I, Rev. 5, "Tank Entry").
- e. KSC Industrial Safety SOP No. 31, (K-V-053, Vol I, Rev. 5, "Manhole Entry").
- f. KHB 1711.1/SF, "Investigation and Reporting Handbook for Accidents, Incidents, and Mission Failures".

APPENDIX A  
GLOSSARY

## GLOSSARY

Decibel (db)

A dimensionless unit used to express a logarithmic relationship between a measured quantity and a referenced quantity. The referenced value used for the measurement of sound is 0.0002 dynes/cm<sup>2</sup>. Zero decibel (re. 0.0002 dynes/cm<sup>2</sup>) is the lowest sound considered barely audible to man at a frequency of 1000 cps.

Dose Rate

Amount of radiation absorbed by an object in units of energy per unit mass per unit time.

Foot-Candle

(A unit of unit illumination) that is, Illumination produced by a unit source at unit distance; hence the foot-candle equivalent to one lumen per square foot.

Infrared

Radiation having free space wave-lengths of  $10^{-1}$  to  $10^{-4}$  centimeters ( $3 \times 10^9$  to  $3 \times 10^{14}$  Hz.)

Ionizing

X-rays, Gamma Rays, and Particles (Neutrons, Beta, Alpha) capable of producing ions, directly or indirectly, in its passage through matter.

Joule

Unit of energy equal to one newton expended along a distance of one meter.

Laser

Light (infrared, visible, ultraviolet) Amplified by means of Stimulated Emission of Radiation.

Lower Explosive Limit (LEL)

The minimum concentration of gas or vapor in air or oxygen which, if ignited, will propagate flame independently of an external ignition source.

## GLOSSARY (Continued)

Octave	An octave is the interval between two sounds having a basic frequency ratio of 2. By extension, the octave is the interval between any two frequencies having the ratio 2 <sup>n</sup> :1. The interval in octaves, between any two frequencies is the logarithm to the base two (or 3.22 times the logarithm to the base 10) of the frequency ratio.
Power Density	The average power per unit area expressed as milliwatts per square centimeter.
Radiating Element	A structure which emits radiation.
Radiation	Energy propagated through space or through a medium in the form of electromagnetic waves; by extension corpuscular emissions such as Alpha, Beta, and Neutron radiation.
Radio-Frequency	Radiation covering free space wavelengths of 10 <sup>4</sup> to 10 <sup>-1</sup> centimeters (microwave region includes wavelengths from 10 <sup>-3</sup> to 10 centimeters, or 3 x 10 <sup>7</sup> to 3 x 10 <sup>9</sup> Hz.).
Tank	A confined space which may contain a hazardous atmosphere and by virtue of its use or physical character may be oxygen deficient. (This includes tanks, pit, ducts, sewers, tunnels, compartments, manholes.)
Threshold Limit Value (TLV)	The air concentration of a toxic material to which the average worker may be exposed 8 hours per day over extended periods of time without apparent injurious or deleterious health effects.

## GLOSSARY (Continued)

Ultraviolet

Radiation in the range of  $10^{-4}$  to  $10^{-6}$  centimeters free space wavelength ( $3 \times 10^{14}$  to  $3 \times 10^{16}$  Hz.).

Watt

Unit of power (Joule/Second).



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